IN THE CLAIMS:

Please amend claims 1, 2, 9-13, 15-20, 24, 26-31, 33, 34, 41-45, 47-52, 56, 58-62.

1. (currently amended) A machine-readable medium having stored thereon instructions, which when executed by one or more processors, cause said one or more processors to perform [the following]a method, said method comprising:

a) creat[e]ing a string that models a trace, said string having a collection of lumped elements[, at least one of said lumped elements having a]including cross capacitors;

b) reduc[e]ing said string to a pi model, said pi model having a pair of cross capacitors; and

c) simulat[e]ing the application of an applied noise voltage to at least one of said cross capacitors.

2. (currently amended) The machine-readable medium of claim 1 wherein said reduc[e]ing said string to a pi model further comprises reducing the number of capacitors and resistors in said string.

3. (original) The machine-readable medium of claim 2 wherein said reducing said string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

4. (original) The machine-readable medium of claim 3 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

5. (original) The machine-readable medium of claim 3 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

6. (original) The machine-readable medium of claim 1 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

7. (original) The machine-readable medium of claim 1 wherein said application of a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

8. (original) The machine-readable medium of claim 7 wherein the ramp time of said voltage ramp is multiplied by a factor to correct for the characteristics of an actual driving transistor.

9. (currently amended) The machine-readable medium of claim 1 wherein said instructions are such that said reduc[e]ing said string to a pi model may be

performed on a first apparatus and said creat[e]ing a string that models a trace may be performed on a second apparatus.

10. (currently amended) The machine-readable medium of claim 1 [further comprising instructions that]wherein said method further comprises adding a resistor to said pi model as a linear source model.

11. (currently amended) The machine-readable medium of claim 1 [further comprising instructions that]wherein said method further comprises allowing a user to observe a noise voltage waveform on a victim node of said pi model.

12. (currently amended) The machine-readable medium of claim 1 [further comprising instructions that]wherein said method further comprises calculat[e]ing the peak noise voltage on a victim node of said pi model caused by said applied noise voltage.

13. (currently amended) The machine-readable medium of claim 1 [further comprising instructions that]wherein said method further comprises applying a second applied noise voltage to a second cross capacitor of said [pi model]cross capacitors.

14. (original) The machine-readable medium of claim 13 wherein said applied noise voltage and said second applied noise voltage are voltage ramps having their end or ramp times in phase.

15. (currently amended) The machine-readable medium of claim 13 [further comprising instructions that]wherein said method further comprises calculat[e]ing the peak noise caused by said applied noise voltage and said second applied noise voltage at a source point of said pi model.

16. (currently amended) The machine-readable medium of claim 13 [further comprising instructions that]wherein said method further comprises calculat[e]ing the peak noise caused by said applied noise voltage and said second applied noise voltage at a load point of said pi model.

17. (currently amended) The machine-readable medium of claim 1 wherein said reduc[e]ing said string to a pi model further comprises reducing said string to a reduced string then reducing said reduced string to a simple string having resistors is series and capacitors in parallel, said capacitors separated by one of said resistances, then reducing said simple string to a pi-model.

18. (currently amended) A machine-readable medium having stored thereon instructions, which when executed by one or more processors, cause said [set

of]one or more processors to perform [the following]a method, said method comprising:

a) creat[e]ing a string that models a trace, said string having a collection of lumped elements, at least one of said lumped elements having a plurality of cross capacitors on a node, each of said cross capacitors corresponding to a different proximate trace;

b) adding said plurality of cross capacitors together to form a reduced string;

c) reduc[e]ing said reduced string to a pi model, said pi model having a cross capacitor; and

d) simulat[e]ing the application of an applied noise voltage to said cross capacitor.

19. (currently amended) The machine-readable medium of claim 18 wherein said reduc[e]ing said reduced string to a pi model further comprises reducing the number of capacitors and resistors in said reduced string.

20. (currently amended) The machine-readable medium of claim 19 wherein said reduc[e]ing said reduced string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

21. (original) The machine-readable medium of claim 20 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

22. (original) The machine-readable medium of claim 20 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

23. (original) The machine-readable medium of claim 18 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

24. (currently amended) The machine-readable medium of claim 18 wherein said applying a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

25. (original) The machine-readable medium of claim 24 wherein said voltage ramp further comprises an equivalent ramp time that approximates the worst case noise caused by said plurality of proximate traces.

26. (currently amended) The machine-readable medium of claim 18 wherein [said instructions are such that] said reduc[e]ing said reduced string to a pi model may be performed on a first apparatus and said creat[e]ing a string that models a trace may be performed on a second apparatus.

27. (currently amended) The machine-readable medium of claim 18 wherein said reduc[e]ing said reduced string to a pi model further comprises reducing said reduced string to a simple string then reducing said simple string to a pi-model.

28. (currently amended) An apparatus, comprising:

a computer having [a] design tool software, said design tool software comprised of instructions that when executed cause a method to be performed, said method comprising[configured to]:

a) recogniz[e]ing a string that models a trace, said string having a collection of lumped elements[, at least one of said lumped elements having a]including cross capacitors;

b) reduc[e]ing said string to a pi model, said pi model having a pair of cross capacitors; and

c) simulat[e]ing the application of an applied noise voltage to at least one of said cross capacitors.

29. (currently amended) A machine-readable medium having stored thereon instructions which when executed by one or more processors cause said one or more processors to perform [the following]a method, said method comprising:

calculat[e]ing a plurality of [discrete samples]incremental values from an overall applied noise voltage waveform and simulat[e]ing the application of each of said plurality of [discrete samples]incremental values to a

cross capacitor, said cross capacitor one of a pair of cross capacitors associated with a pi model, said pi model reduced from a string.

30. (currently amended) The machine-readable medium of claim 29 [further comprising instructions that]wherein said method further comprises assembl[e]ing a plurality of observed noise voltages from the simulation of the application of each of said discrete samples.

31. (currently amended) The machine-readable medium of claim 30 [further comprising instructions that]wherein said method further comprises displaying an overall observed noise voltage waveform produced from said plurality of observed noise voltages.

32. (original) The machine-readable medium of claim 29 wherein said overall applied noise voltage waveform is a ramp.

33. (currently amended) A method, comprising:

a) creat[e]ing a string that models a trace, said string having a collection of lumped elements[, at least one of said lumped elements having a]including cross capacitors;

b) reduc[e]ing said string to a pi model, said pi model having a pair of cross capacitors; and

c) simulat[e]ing the application of an applied noise voltage to at least one of said cross capacitors.

34. (currently amended) The method of claim 33 wherein said reduc[e]ing said string to a pi model further comprises reducing the number of capacitors and resistors in said string.

35. (original) The method of claim 34 wherein said reducing said string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

36. (original) The method of claim 35 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

37. (original) The method of claim 35 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

38. (original) The method of claim 33 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

39. (original) The method of claim 33 wherein said application of a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

40. (original) The method of claim 39 wherein the ramp time of said voltage ramp is multiplied by a factor to correct for the characteristics of an actual driving transistor.

41. (currently amended) The method of claim 33 wherein said reduc[e]ing said string to a pi model is performed on a first apparatus and said creat[e]ing a string that models a trace is performed on a second apparatus.

42. (currently amended) The method of claim 33 further comprising adding a resistor to said pi model as a linear source model.

43. (currently amended) The method of claim 33 further comprising observ[e]ing noise voltage on a victim node of said pi model.

44. (currently amended) The method of claim 33 further comprising calculat[e]ing the peak noise voltage on a victim node of said pi model caused by said applied noise voltage.

45. (currently amended) The method of claim 33 further comprising applying a second applied noise voltage to a second cross capacitor of [said pi model]cross capacitors.

46. (original) The method of claim 45 wherein said applied noise voltage and said second applied noise voltage are voltage ramps having their end or ramp times in phase.

47. (currently amended) The method of claim 45 further comprising calculat[e]ing the peak noise caused by said applied noise voltage and said second applied noise voltage at a source point of said pi model.

48. (currently amended) The method of claim 45 further comprising calculat[e]ing the peak noise caused by said applied noise voltage and said second applied noise voltage at a load point of said pi model.

49. (currently amended) The method of claim 33 wherein said reduc[e]ing said string to a pi model further comprises reducing said string to a reduced string then reducing said reduced string to a simple string having resistors and capacitors in parallel, said capacitors separated by one of said resistors then reducing said simple string to a pi-model.

50. (currently amended) A method, comprising:

a) creat[e]ing a string that models a trace, said string having a collection of lumped elements, at least one of said lumped elements having a plurality of

cross capacitors on a node, each of said cross capacitors corresponding to a different proximate trace;

b) adding said plurality of cross capacitors together to form a reduced string;

c) reduc[e]ing said reduced string to a pi model, said pi model having a cross capacitor; and

d) simulat[e]ing the application of an applied noise voltage to said cross capacitor.

51. (currently amended) The method of claim 50 wherein said reduc[e]ing said reduced string to a pi model further comprises reducing the number of capacitors and resistors in said reduced string.

52. (currently amended) The method of claim 51 wherein said reduc[e]ing said reduced string to a pi model further comprises reducing six capacitors and two resistors in said string to four capacitors and one resistor.

53. (original) The method of claim 52 wherein said reduction of six resistors and four capacitors is performed according to an Elmore influenced reduction method.

54. (original) The method of claim 52 wherein said reduction of resistors and capacitors is performed according to an O'Brien/Savarino influenced reduction method.

55. (original) The machine-readable medium of claim 50 wherein said string further comprises a number of paths, said reduction of said string to a pi model performed for one of said paths.

56. (currently amended) The method of claim 50 wherein said applying a noise voltage further comprises applying a voltage ramp as said applied noise voltage.

57. (original) The method of claim 56 wherein said voltage ramp further comprises an equivalent ramp time that approximates the worst case noise caused by said plurality of proximate traces.

58. (currently amended) The method of claim 50 wherein said reduc[e]ing said reduced string to a pi model is performed on a first apparatus and said creat[e]ing a string that models a trace is performed on a second apparatus.

59. (currently amended) The method of claim 50 wherein said reduc[e]ing said reduced string to a pi model further comprises reducing said reduced string to a simple string then reducing said simple string to a pi-model.

60. (currently amended) A method, comprising:

calculat[e]ing a plurality of [discrete samples]incremental values from an overall applied noise voltage waveform and simulat[e]ing the application of each of said plurality of [discrete samples]incremental values to a

cross capacitor, said cross capacitor one of a pair of cross capacitors associated with a pi model, said pi model reduced from a string.

61. (currently amended) The method of claim 60 further comprising assembl[e]ing a plurality of observed noise voltages from the simulation of the application of each of said [discrete samples]incremental values.

62. (currently amended) The method of claim 61 further comprising displaying an overall observed noise voltage waveform produced from said plurality of observed noise voltages.

63. (original) The method of claim 60 wherein said overall applied noise voltage waveform is a ramp.

COMMENTS

The enclosed is responsive to the Examiner's Office Action mailed on April 9, 2003. At the time the Examiner mailed the Office Action claims 1 through 63 were pending. By way of the present response the Applicant has: 1) neither canceled nor added any claims; and, 2) amended claims 1, 2, 9-13, 15-20, 24, 26-31, 33, 34, 41-45, 47-52, 56, 58-62. The Applicant respectfully requests reconsideration of the present application and the allowance of claims 1 through 63.

The Examiner has rejected each of the Applicant's independent claims 1, 18, 28, 29, 33, 50 and 60 under 35 USC 103 as being obvious in light of a prior art combination that includes: US Patent No. 6,192,330 (hereinafter, "Nakamura"), US Patent No. 6,314,546 (hereinafter "Muddu") and US Patent No. 6,028,989 (hereinafter "Dannsky"). The Examiner effectively reasoned that: 1) Nakamura teaches a string model; 2) Muddu teaches modeling a trace as a pi model; and 3) Dannsky teaches lumped elements, cross capacitors and applied noise voltage.

Claims 1, 28, 29, 33 and 60

"To establish a *prima facie* case of obviousness ... the prior art reference (or references when combined) must teach or suggest all the claim limitations." MPEP 2143 The Applicant respectfully submits that each of the Applicant's independent claims 1, 28, 29, 33 and 60 are patentable over the combined teachings of Nakamura, Muddu and Dansky at least because the combined

teachings of Nakumura, Muddu and Dansky fail to disclose, teach or suggest "reducing a string to a pi model, the pi model having a pair of cross capacitors" or "a pair of cross capacitors associated with a pi model, the pi model reduced from a string". The Applicant supports the insufficiency of the Examiner's theory of rejection by way of the following discussion of each of the Nakumura, Muddu and Dansky references and their application to the claim elements at issue.

the Nakamura reference

Nakamura is an irrelevant prior art reference with respect to "reducing a string to a pi model, the pi model having a pair of cross capacitors" or "a pair of cross capacitors associated with a pi model, the pi model reduced from a string". The string to which the Applicant's claims refer is "a lumped element model of a trace". See, Applicant's specification page 9, lines 20-21. By contrast, the string of Nakamura represents "*the surface* of . . . a semiconductor element. See, Nakamura, Col. 7, lines 23-36. Thus, whereas the Applicant's string is related to circuit modeling (e.g., including resistances, capacitances, etc.), Nakamura's string is related to the simulation of a manufactured semiconductor wafer's surface topography (e.g., so as to involve specific processing steps and materials such as "vacuum vapor deposition" and "Ti"). Therefore Nakamura has absolutely no relevance to the Applicant's use of the term "string".

the Muddu reference

The Muddu reference is directed to efficiently simulating the effects of interconnect line delay between gates rather than simulating the effects of coupled noise between interconnect lines. As such, although Muddu teaches the use of a pi model for circuit modeling, Muddu limits itself only to representing a single interconnect tree with a pi model without regard for any cross capacitance that may exist; and, likewise, Muddu does not disclose, teach, suggest or refer to anything that relates to cross capacitance or noise.

That Muddu is directed solely to interconnect line delay rather than coupled noise between interconnect lines is notorious in various instances. Most notably, Col. 1, lines 18 – 40 and Fig. 1 of Muddu only refer to or show interconnection lines between gates and do not refer to or show capacitive coupling between interconnection lines. By contrast, page 2, line 11 through page 4, line 7 and Fig. 1A of the Applicant's specification clearly refers to a pair of interconnect lines and the capacitive coupling that exists between them so as to introduce unwanted noise upon an interconnect line. Moreover, the pi modeling techniques ("accurate" and "open-ended/heuristic") taught by Muddu are clearly devoted only to the analysis of a single interconnect tree without reference to capacitive coupling between other interconnect trees (e.g., see, Muddu Col. 5, lines 41 – 44: "[i]n the O'Brien/Savarino (accurate RC) Π model, the interconnect tree load is approximated by an RC Π model with a resistance and capacitance equaling the total interconnect resistance (R_{tot}) and capacitance (C_{tot}), respectively. . . "; and see, Muddu Col. 6, lines 16 – 21: " . . . [t]he open-ended RC Π model approximates the entire interconnect tree 104

by an equivalent open-ended RC line whose resistance (R_{tot}) and capacitance (C_{tot}) 104d are equal to the total interconnect resistance and capacitance, as shown in FIG. 5(a)"). Lastly, Muddu appears to make no reference to coupling between neighboring interconnect lines, cross capacitance, noise and the like.

As such, Muddu simply does not disclose teach or suggest "reducing a string to a pi model, the pi model having a pair of cross capacitors" or "a pair of cross capacitors associated with a pi model, the pi model reduced from a string".

the Dansky reference

Unlike Muddu, the Dansky reference is directed to the effects of cross-coupled noise. The only discussion of a model as taught by Dansky appears at Col. 7, lines 9 – 60. Note that the model of Dansky does not include a pair of cross capacitors and only includes a single cross capacitor model element (See, Dansky, Col. 7, line 16: "2. Mutual capacitance between the two nets (C12 mf)"). Moreover, even if Dansky employs such a model for each and every path/segment of a interconnect net (See, Dansky, Col. 6 line 21 through Col. 7, line 9) it is clear that no reduction process is described. Better said, if Dansky reduces the entire net to the model described at Col. 7, lines 9 – 60; then, Dansky does not teach a model having a "pair of cross capacitors". Or, if Dansky models an entire net by forming the model of Dansky for each path/segment of a net; then, Dansky does not teach a reduction process.

Either way, Dansky cannot be said to disclose, teach or suggest: "reducing a string to a pi model, the pi model having a pair of cross capacitors" or "a pair of cross capacitors associated with a pi model, the pi model reduced from a string".

conclusion

Because each of Nakamura, Muddu and Dansky do not disclose teach or suggest "reducing a string to a pi model, the pi model having a pair of cross capacitors" or "a pair of cross capacitors associated with a pi model, the pi model reduced from a string" it is impossible for a combination Nakamura, Muddu and Dansky to anticipate each and every element of the Applicants independent claims 1, 28, 29, 33 and 60. As such, independent claims 1, 28, 29, 33 and 60 and their corresponding dependent claims 2-17, 30-32, 34-49, 61-63 are presently in allowable form.

Claims 18 and 50

"To establish a *prima facie* case of obviousness ... the prior art reference (or references when combined) must teach or suggest all the claim limitations." MPEP 2143 The Applicant respectfully submits that each of the Applicant's independent claims 18 and 50 are patentable over the combined teachings of Nakamura, Muddu and Dansky at least because the combined teachings of Nakumura, Muddu and Dansky fail to disclose, teach or suggest "a plurality of cross

capacitors on a node, each of the cross capacitors corresponding to a different proximate trace". The Examiner is referred to Page 26, line 11 through Page 29, line 10 of the Applicant's specification where it is clear that the Applicant is describing a modeling process in which the coupled noise effects of multiple nets are being accounted for.

the Nakamura and Muddu references

The Nakamura and Muddu references can be discounted with the same reasoning provided above. That is, as neither reference discloses, teaches or suggests any cross capacitance – neither reference can be said to cover "a plurality of cross capacitors on a node, each of the cross capacitors corresponding to a different proximate trace".

the Dansky reference

The Dansky reference clearly states that "[o]nly one perp and one victim net are used". Dansky, Col. 7, lines 12-13. That is, Dansky is clearly limited to cases where the effect of noise induced by only a single perpetrator net is analyzed. As such, Dansky clearly does not provide for analysis of "different proximate trace[s]" and, as a consequence, can not cover "a plurality of cross capacitors on a node, each of the cross capacitors corresponding to a different proximate trace".

conclusion

Because each of Nakamura, Muddu and Dansky do not disclose teach or suggest "a plurality of cross capacitors on a node, each of the cross capacitors corresponding to a different proximate trace" it is impossible for a combination Nakamura, Muddu and Dansky to anticipate each and every element of the Applicants independent claims 18 and 50. As such, independent claims 18 and 50 and their corresponding dependent claims 19-27 and 51-59 are presently in allowable form.

CONCLUSION

Believing all claims to be patentable, the Applicant respectfully requests the allowance of same.

Applicants respectfully submit the present application is in condition for allowance. If the Examiner believes a telephone conference would expedite or assist in the allowance of the present application, the Examiner is invited to call Robert O'Rourke at (408) 720-8300.

If any additional fee is required, please charge Deposit Account No. 02-2666.

Respectfully submitted,

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